

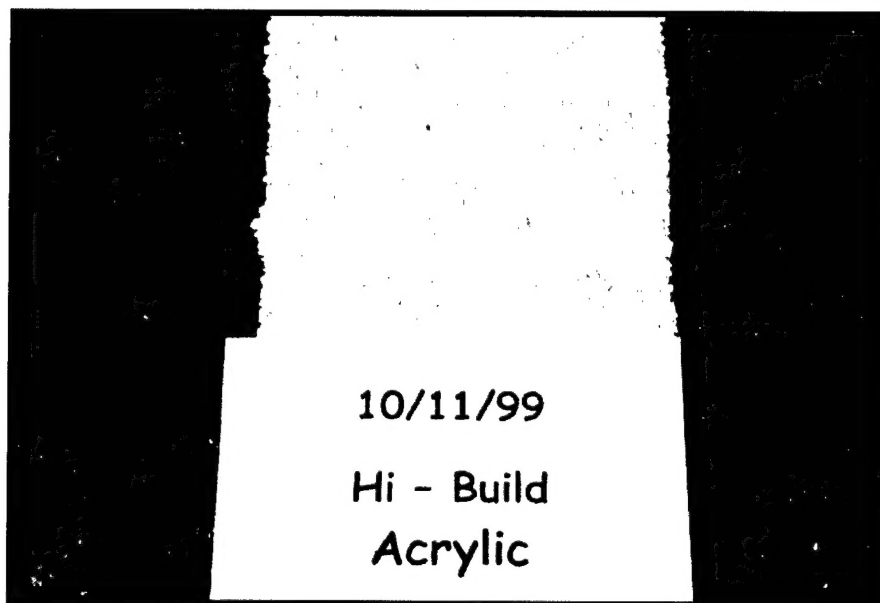


Naval Facilities Engineering Service Center  
Port Hueneme, California 93043-4370

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## Special Publication SP-2088-SHR

### GUIDANCE DEVELOPMENT: HIGH BUILD ACRYLIC COATING (HBAC) FOR MARKING PAVEMENTS



by

C. Dave Gaughen  
Joseph H. Brandon

August 2000

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## EXECUTIVE SUMMARY

The objective of this effort was to implement the use of pavement markings based on a High Build Acrylic Coating (HBAC). HBACs are liquid-applied, waterborne, 100 % acrylic marking paints suitable for use in marking concrete, asphaltic concrete, asphaltic wearing surfaces, and overcoating sound but abraded acrylic markings. HBACs can be applied at two to three times the thickness of conventional marking paints and are appropriate for use in marking crosswalk bars, stop bars, railroad crossings, lettering, centerlines, skip lines, and edge lines, with or without reflective glass beads.

The following commercial guidance documents were drafted and are presented in the Appendices: A) Detailed Performance Standard (DPS), B) Intended Use Standard (IUS), and C) Commercial Item Description (CID). Following the Master Painters Institute's (MPI) approval, either the DPS or IUS will be inserted directly into Naval Facilities Engineering Command (NAVFAC) Guide Specification (NFGS)-02761 "Pavement Markings." In the interim, NFGS-02761E was amended to include the HBAC through descriptive performance requirements and is presented in Appendix D. Appendix E contains a new HBAC specification. At this time, the specification presented in Appendix E or the "draft" CID can be used to specify the HBAC.

Future work is scheduled for completion in FY 01 and includes: 1) Work with custodian of NFGS-02761E "Pavement Markings" to adopt current amendments, 2) Present amended NFGS to NAVFAC Code 15 (Criteria Office), 3) Assist MPI in perfecting the new marking paint standard, 4) Amend NFGS-02761 to include the new MPI standard, 5) Present amended NFGS to NAVFAC Code 15, 6) Develop HBAC Technical Data Sheet (TDS), and 7) Introduce work to Tri-Services.

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## **INTRODUCTION**

The objective of this effort was to implement the use of pavement markings based on a High Build Acrylic Coating (HBAC). The new guidance will be placed into Naval Facilities Engineering Command (NAVFAC) Guide Specification (NFGS)-02761 "Pavement Markings." This work was sponsored by NAVFAC Headquarters, Public Works Facilities (PWF) Management.

## **BACKGROUND**

In response to requests by the Naval Airfield Criteria Manager and the Naval Pavement Center of Expertise, the Naval Facilities Engineering Service Center (NFESC) conducted an investigation into the causes of acrylic paint cracking on asphaltic pavements<sup>1</sup>. As part of the effort, the "High Build Acrylic Coating (HBAC)" was one of seven paints evaluated. When compared to the "Low Build" acrylic marking paints, the "HBAC" outperformed the "Low Build" acrylics<sup>2</sup>.

HBACs are liquid-applied, waterborne, 100 % acrylic marking paints suitable for use in marking concrete, asphaltic concrete, asphaltic wearing surfaces, and overcoating sound but abraded acrylic markings. HBACs can be applied at two to three times the thickness of conventional marking paints and are appropriate for use in marking crosswalk bars, stop bars, railroad crossings, lettering, centerlines, skip lines, and edge lines, with or without reflective glass beads. HBAC benefits include: 1) Environmentally acceptable, 2) Clean-up with soap/water, 3) Application at high builds, 4) Excellent abrasion resistance, 5) Good flexibility, 6) Very low thermal expansion, and 7) Excellent resistance to cracking<sup>3</sup>. HBACs have been commercially available for approximately two years and represent "State-Of-The-Art" marking paint technology<sup>4</sup>.

In FY 00, the Master Painters Institute (MPI) was selected by NAVFAC's Paints and Coatings Center of Expertise to provide consensus standards for use in the architectural painting of Naval facilities<sup>5,6</sup>. Other Government agencies, such as General Services Administration (GSA), Army, Air Force, and Veterans Administration (VA), have also shown interest in adopting MPI architectural coating standards<sup>7</sup>. Consequently, this work will be forwarded to MPI's Technical Director for inclusion as a new pavement marking standard.

## **GUIDANCE DEVELOPMENT**

Three commercial guidance documents were drafted and are presented in the Appendices: A) Detailed Performance Standard (DPS), B) Intended Use Standard (IUS), and C) Commercial Item Description (CID). The DPS and IUS will be forwarded to MPI for continued joint development and future approval. The CID was developed and used as the basis to produce the DPS and IUS. The new MPI standard will be placed into NFGS-02761E "Pavement Markings." In the interim, minimum HBAC requirements were appropriately inserted into NFGS-02761E. The amended NFGS is presented in Appendix D and each new amendment has been highlighted. At this time, the specification presented in Appendix E "HBAC for Marking Pavements" or the "draft" CID can be used to specify the HBAC.

## **FUTURE TASKS**

- Work with custodian of NFGS-02761E "Pavement Markings" to adopt current amendments
- Present amended NFGS to NAVFAC Code 15 (Criteria Office)
- Assist MPI in perfecting "one" of potentially "two" new MPI marking paint standards
- Amend NFGS-02761 to include the HBAC as a new MPI standard
- Present amended NFGS to NAVFAC Code 15
- Develop HBAC Technical Data Sheet (TDS)
- Introduce work to Tri-Services

Each future task is scheduled for completion in FY 01. Additional funding will be required to develop the Technical Data Sheet (TDS).

## REFERENCES AND ENDNOTES

1. C. Dave Gaughen, "Investigation into Acrylic Paint Cracking (APC) on Asphaltic Pavements: TM-2328-SHR," Naval Facilities Engineering Service Center (NFESC), January 2000.
2. Ibid.
3. Ibid.
4. Ibid.
5. [www.paintinfo.com](http://www.paintinfo.com)
6. Official letter from NFESC to the Commander, Naval Facilities Engineering Command (NAVFAC) Code CHE and PW, dated 26 April 2000, Ser. ECS 63/109.
7. Ibid.

**APPENDIX A**

**DETAILED PERFORMANCE STANDARD**

**“DRAFT”**

**“HIGH BUILD, LATEX TRAFFIC MARKING PAINT”**

## **1 SCOPE**

- 1.1 This standard is for a water-based, high build traffic marking paint, available in standard white and yellow. Can be applied at two to three times the thickness of conventional marking paints, with or without reflective beads.
- 1.2 For recommended substrates see Section 7.

## **2 TOXIC ELEMENTS**

- 2.1 This paint will be manufactured to conform to the current Federal, State and municipal safety and environmental regulations in regards to toxic elements.

## **3 REFERENCES**

- 3.1 American Society for Testing and Materials (ASTM): Vol.6.01, 6.02, 9.01,14.01
- 3.2 International Concrete Repair Institute (ICRI): Guideline No. 03732
- 3.3 MPI Maintenance Repainting Manual
- 3.4 U.S. Federal Specifications: Fed. Std. 595B, TT-B-1325C

## **4 REQUIREMENTS**

The coating shall be suitable for application by brush, roller, and/or airless or conventional spray, with or without reflective beads.

<b><u>Test</u></b>	<b><u>Required</u></b>	<b><u>Method*</u></b>	<b><u>Notes</u></b>
4.1) Resin System	Water-borne 100 % acrylic	ASTM D 2621	
4.2) Volume Solids	58 % (min)	ASTM D 2697	
4.3) Volatile Organic Compounds	150 g/l (max)	ASTM D 3960	
4.4) Color, White	37925 (visual match)	FED. STD. 595B	(5.2)
4.5) Color, Yellow	33538 (visual match)	FED. STD. 595B	(5.3)
4.6) Lead	0.06 % (max)	ASTM D 3335	
4.7) Cadmium	0.06 % (max)	ASTM D 3335	
4.8) Chromium	0.00 %	ASTM D 3718	
4.9) Mercury	0.1 % (max)	ASTM D 3624	
4.10) Shore D Hardness	45 (min)	ASTM D 2240	(5.4)
4.11) Adhesion	140 psi (min)	ASTM D 4541	(5.5)
4.12) Water Absorption	9.0 % weight increase (max) at 168 hours immersion	ASTM D 471	(5.6)
4.13) Flexibility	1/8 inch mandrel bend at 5.0 mils DFT	ASTM D 522 (Method B)	(5.7)
4.14) Dry, No Pick-Up	10 minutes (max) at 25 mils WFT	ASTM D 711	
4.15) Thick Application	No cracking or curling at 65 mil WFT		(5.8)
4.16) Accelerated Weathering, Yellow	Color loss to 33655 (max) at 2500 hours UV exposure	ASTM G 53, FED. STD. 595B	(5.9)

\*Unless otherwise noted, number of samples, sample preparation, sample cure, and testing conditions shall be those as defined in Note 5.1.

## **5 NOTES TO METHODS**

### **5.1 Number of Samples, Sample Preparation, Sample Cure, and Testing Conditions**

Unless otherwise specified, a minimum of three coating samples per test shall be prepared. Sample preparation shall be carried out in a well-ventilated room, free from dust, direct drafts, combustive gasses and laboratory fumes. Apply paint per ASTM D 823 and ASTM D 3924. Samples shall cure a minimum of one-week per ASTM D 3924, and with testing performed at the same conditions.

### **5.2 White Color**

Properly cured "white" paint shall be a visually equal color match to Color No. 37925 of Federal Standard 595B "Colors used in U.S. Government Procurement."

### **5.3 Yellow Color**

Properly cured "yellow" paint shall be a visually equal color match to Color No. 33538 of Federal Standard 595B "Colors used in U.S. Government Procurement."

### **5.4 Shore D Hardness**

The resulting cured samples as prepared in Note 5.8 shall each be tested in accordance to ASTM D 2240. Each sample tested shall have a minimum Shore D number of not less than 45.

### **5.5 Adhesion**

Adhesion testing shall be performed using either in-situ field substrates or laboratory prepared samples with a minimum tensile strength, at the substrate's surface and at room temperature, exceeding 170 psi. Apply the coating to properly prepared one-square foot sections of both concrete and asphaltic concrete at 15.0 mils to 30.0 mils WFT, and cure for a minimum of one week at  $\approx 23^{\circ}\text{C}$ ,  $\approx 50\%$  Relative Humidity. Three adhesion tests per coated substrate at no more than  $25^{\circ}\text{C}$  shall be performed in accordance to ASTM D 4541, and with minimum average results no less than 140 psi.

### **5.6 Water Absorption**

Prepare a free film of the coating under test using a draw-bar or equivalent device over teflon sheet or other suitable bond-breaker to produce a dry film at 15 mils nominal thickness. Cure paint under the conditions of Note 5.1 and test in accordance to ASTM D 471. Three samples with dimension of 2 inch x 1 inch x 0.015 inch shall be immersed in tap water for a minimum period of 168 hours. Following immersion, each sample shall increase in weight by no more than 9.0 % to receive a passing rating.

### **5.7 Flexibility**

Apply a wet film of the coating under test using a draw-bar or other suitable device to produce a uniform film at 5.0 mil DFT. Cure paint for a minimum of one week under the conditions of Note 5.1 and test in accordance to ASTM D 522, Method B using a 1/8 inch mandrel. Following bend, visually examine paint for cracking and lifting from substrate. The painted area in and surrounding bend shall be free of visual defects to receive a passing rating.

#### 5.8 Thick Application

Using 3M double-stick, foam mounting tape (or equal) with a nominal thickness of 65 mils, apply a rectangular mold with inner dimensions of 3 inch x 10 inch to a clean aluminum sample approximately sized at 6 inch x 12 inch x 1/8 inch. Do not remove the tape's plastic backing. Mix and apply excess paint into mold. Remove excess paint, by squeegee or other appropriate draw down technique, to a uniform thickness equal to the tape's height. Paint application and draw down shall be performed within a period of no more than 60 seconds. Approximately one to two minutes following draw down, remove tape from sample and allow coating to cure for a minimum period of one-week, and under the conditions of Note 5.1. Using a micrometer or other appropriate device, measure cured coating thickness (less sample thickness) to confirm resulting coating application was at or above 38 mils DFT. Following cure, inspect coating for visual signs of cracking and curling. Coating shall receive a passing rating if applied greater than 38 mils DFT and visually free of both cracking and curling: passing rating per sample for a total of three samples.

#### 5.9 Accelerated Weathering, Yellow Paint

Apply yellow paint at 10 mils  $\pm$  2 mils DFT over a suitably sized, clean aluminum substrate, and cure for a minimum of 48 hours under the conditions of Note 5.1: four individual yellow samples shall be prepared. Expose three samples to continuous Ultraviolet (UV) light for 2500 hours, without cycled condensation, in accordance to ASTM-G-53: UVA-340 lamps shall be used in the testing apparatus. Following exposure, compare the three exposed samples to the "one" non-exposed sample using Fed. Std. 595B colors 33538 and 33655 as visual references: evaluate exposed samples for degree of visual color loss. Yellow paint shall receive a passing rating if each exposed sample appears visually equivalent to the non-exposed sample and, in addition, displays color loss no greater than Fed. Std. 595B color 33655.

### **6 QUALITY ASSURANCE**

#### 6.1 Records

It will be the manufacturer's responsibility to keep retained samples of each batch of qualified product for a minimum of two years. Quality control records of qualified products must be maintained for a minimum of three years.

#### 6.2 Formulation Changes

To maintain the product listing in the MPI Architectural Specification Manual and the MPI Maintenance Repainting Manual, the manufacturer of a qualified product must notify, in writing, the MPI Testing Authority of:

a) Any changes to the paint formula in regards to types of materials, or ratios of materials, that may alter the performance of the finished product or limit its use as specified in the MPI manuals. A testing report that confirms the product continues to meet the requirements of the standard will be required for evaluation. Evaluation of this report may result in a requirement for confirmation testing to be performed by MPI. All costs associated with any testing deemed to be required shall be borne by the manufacturer.

b) Any changes to the packaging or label.

## **7 INTENDED USES**

- 7.1 The paint complying with this specification is intended for use in marking concrete, asphaltic concrete, asphaltic wearing surfaces, and overcoating sound but abraded acrylic marking paints. The paint can be applied at two to three times the thickness of conventional marking paints and is appropriate for use in marking crosswalk bars, stop bars, railroad crossings, lettering, centerlines, skip lines, and edge lines. Drop-on glass beads meeting the requirements of Federal Specification (FS) TT-B-1325C "Beads (Glass Sphere) Retro-Reflective", Type I, Gradation A, can be applied directly into the wet paint at approximately 6.0 pounds per gallon applied paint.
- 7.2 **Overcoating Existing Marking Paints.** The paint can be used to overcoat sound acrylic marking paints with no more than 40 mils of built-up paint. When tested for adhesion (ASTM-D-4541), a sound marking paint may exhibit either greater than 140 psi adhesion or produce 100 % cohesive failures within the pavement. Overcoating is generally required when less than 77 % of the marking paint covers the substrate (ASTM-D-913).
- 7.3 **Coating Concrete.** New concrete may require a cure period of 60 days, or more, prior to the application of the acrylic marking paint. Remove unsound coatings, curing compounds, laitance, efflorescence, biological growth (mildew, fungus), dirt, oils, chalk, dust, and chloride salt contamination. Resulting surfaces are to contain sound coatings with a dull appearance and a sound substrate. On uncoated concrete, either light shot blasting to a profile equal to ICRI-CSP 3 or high-pressure water jetting enhances marking paint performance and is highly recommended.
- 7.4 **Coating Asphaltic Surfaces.** Remove unsound coatings, biological growth (mildew, fungus), dirt, oils, chalk, dust, and chloride salt contamination. Resulting surfaces are to contain sound coatings with a dull appearance and a sound substrate. On new asphaltic surfaces, two coats at half the normal application thickness and with a waiting period of several weeks between coats, may be required to reduce surface cracking, paint curling, and coating discoloration. To reduce rust bleed from asphaltic concrete containing iron sulfide aggregate, two coats at half the normal thickness, with a waiting period from one to several days between coats, may be required.

## **8 LABELING**

- 8.1 Each container shall be labeled to show:
- i) The name of the manufacturer
  - ii) The manufacturer's address
  - iii) The manufacturer's batch number and product code number
  - iv) The date of manufacture of packaging
  - v) The color number
  - vi) Application and thinning instructions
  - vii) Storage requirements
  - viii) MPI standard and code number for listing
  - ix) Any required safety information required by Federal, State or Provincial safety authority

## **9 CALL-UP TESTING AND LISTING REQUIREMENTS**

- 9.1 Before initial qualification and approval for listing, products shall be tested by MPI to assure compliance with the specified requirements of the standard. After listing, continued compliance with the specified requirements of the standard will be confirmed by period MPI confirmation testing.

Both initial and confirmation testing will be performed by MPI and the applicable costs billed to the manufacturer.

## **10 PARTIAL LIST OF COMMERCIALY AVAILABLE HBACs**

<u>Products</u>	<u>Manufacturers</u>
Pervo 6050, White Pervo 6053, Yellow	Pervo Paints 6624 Stanford Ave. Los Angeles, CA 90001 (323) 758 - 1147
UC-1516, White UC-3588, Yellow	Vogel Traffic Services 1920 Albany Place South PO Box 140 Orange City, IA 51041 (712) 737 - 4016
Legend Build, #2712A9, White Legend Build, #2713A9, Yellow	TMT-Pathway 1021 N. Mission Road Los Angeles, CA 90033 (800) 338 - 7680

**APPENDIX B**

**INTENDED USE STANDARD**

**“DRAFT”**

**“HIGH BUILD, LATEX TRAFFIC MARKING PAINT”**

A water-based, high build traffic marking paint, available in standard white and yellow, for use in marking concrete, asphaltic concrete, asphaltic wearing surfaces, and overcoating sound but abraded acrylic marking paints. Can be applied at two to three times the thickness of conventional marking paints, with or without reflective beads. Is appropriate for use in marking crosswalk bars, stop bars, railroad crossings, lettering, centerlines, skip lines, and edge lines. Application methods include: brush, roller, and/or airless or conventional spray.

Volume Solids:	58 % (minimum)
Volatile Organic Compounds:	150 g/l (maximum)
Shore D Hardness:	45 (minimum)
Adhesion:	140 psi (minimum)
Water Absorption:	9.0 % weight gain (maximum) at 168 Hrs. immersion
Flexibility:	1/8 inch mandrel at 5.0 mils DFT
Dry, No Pick-Up:	10 minutes at 23°C (maximum) 25.0 mils WFT
Thick Application:	65 mils WFT, no cracking or curling

## **APPENDIX C**

### **COMMERCIAL ITEM DESCRIPTION (CID)**

**“DRAFT”**

**“TRAFFIC MARKING PAINT:  
WATERBORNE, HIGH BUILD ACRYLIC”**

## COMMERCIAL ITEM DESCRIPTION (CID)

### TRAFFIC MARKING PAINT: WATERBORNE, HIGH BUILD ACRYLIC

The General Services Administration has authorized the use of this Commercial Item Description (CID) by all federal agencies.

1. **SCOPE.** This Commercial Item Description (CID) covers a liquid, high build traffic marking paint for use in marking concrete, asphaltic concrete, asphaltic wearing surfaces, and overcoating sound but abraded acrylic marking paints. The paint is suitable for use either alone or to bind reflective beads and can be applied at two to three times the thickness of conventional marking paints. The paint produces upraised markings and is appropriate for use in marking crosswalk bars, stop bars, railroad crossings, lettering, centerlines, skip lines, and edge lines.

2. **CLASSIFICATION.** This CID describes one type of waterborne 100 % acrylic marking paint.

### 3. SALIENT CHARACTERISTICS.

#### 3.1 General Requirements.

3.1.1 **Materials.** The coating shall be a water-dispersed liquid based on a waterborne 100 % acrylic resin.

3.1.2 **Condition in Container.** The paint, as received, shall be ready-to-use and shall show no evidence of biological growth, livering, skinning, putrefaction, corrosion of the container, or hard settling of the pigment. Paint shall be readily mixed and dispersible to a uniform condition within five minutes of mechanical stirring. Each non-conforming condition shall be grounds for rejection.

3.1.3 **Application Properties.** The marking paint shall be suitable for application/curing at temperatures (air, substrate) ranging from 10 – 43 degrees C (50 - 110 degrees F), and at thicknesses from 75 – 900 microns (3 - 36 mils) Dry Film Thickness (DFT). The acrylic marking paint shall not sag or run when applied by brush, airless spray, or roller at the manufacturer's recommended thickness. The cured paint shall appear aesthetically pleasing and, when examined under 30X magnification, shall be absent of visible cracks and fractures.

3.2 **Special Requirements.** Unless otherwise stated, all routine and referee testing shall be done at the conditions specified in ASTM-D-3924.

3.2.1 **Color Availability.** The acrylic marking paint shall be furnished in white and yellow as specified in Table 1.

3.2.2 **Quantitative Requirements.** The acrylic marking paint shall meet the quantitative requirements as listed in Table 1.

Beneficial comments, recommendations, additions, deletions, clarification, etc. and any other data which may improve this document should be sent to: Naval Facilities Engineering Service Center (NFESC), Code ESC 63/Gaughen, 1100 23 <sup>rd</sup> Ave., Port Hueneme CA 93043-4320.
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**TABLE I**  
**REQUIREMENTS**

PROPERTY	REQUIREMENT	ASTM TEST METHOD and/or Paragraph No.
<b>Prohibited Materials</b>		
Lead, max.	0.06 %	ASTM-D-3335
Cadmium, max.	0.06 %	ASTM-D-3335
Chromium, max.	0.00 %	ASTM-D-3718
Mercury, max.	0.1 %	ASTM-D-3624
<b>Colors</b>		
White, visual match	37925	Fed. Std. 595B
Yellow, visual match	33538	Fed. Std. 595B
Percent volume solids, min.	58 %	ASTM-D-2697
Volatile Organic Compounds, max.	150 g/l	ASTM-D-3960
Liquid plasticizers, max.	0.5 % plasticizers by resin volume	See note 1/
Shore D hardness	45 – 60	ASTM-D-2240
Adhesion to concrete and asphaltic surfaces, min.	140 psi or 100 % cohesive failure in substrate	ASTM-D-4541
Water absorption @ 168 hrs immersion, max.	9.0 % weight increase	ASTM-D-471
1/8" mandrel bend @ 5 mils Dry Film Thickness (DFT), one-week cure	No lifting, cracking, chipping, or other failures	ASTM-D-522, Method B
No pick up @ 25 mils wet, max.	10 minutes	ASTM-D-711
Application @ 65 mils wet, one coat, 1-week cure	No visual cracking or curling	3.2.3
Accelerated weathering, Yellow, 2500 hours UV exposure, max. color loss	Max. color loss to 33655 (Fed. Std. 595B)	ASTM-G-53 and 3.2.4

1/ A manufacturer's approved test method shall be used to determine this parameter.

**3.2.3 Test for Visual Cracking and Curling.** Using 3M double-stick, foam mounting tape (or equal) with a nominal thickness of 1625 microns (65 mils), apply a rectangular mold with inner dimensions of 7.6 cm x 25.5 cm (3 in x 10 in) to a clean aluminum sample approximately sized at 15 cm x 30 cm x 0.30 cm (6 in x 12 in x 1/8 in). The tape's plastic backing is not to be removed. Mix and apply excess paint into mold. Remove excess paint, by squeegee or other appropriate draw down technique, to a uniform thickness equal to the tape's height. Paint application and draw down shall be performed within a period of no more than 60 seconds. Approximately one to two minutes following draw down, remove tape from sample and allow coating to cure for a minimum period of one-week. Using a micrometer or other appropriate device, measure cured coating thickness (less sample thickness) to confirm resulting coating application was at or above 950 microns (38 mils) DFT. Inspect coating for visual signs of cracking and curling. Following a one-week cure, coating shall receive a passing rating if applied greater than 950 microns (38 mils) DFT and visually free of both cracking and curling.

**3.2.4 Accelerated Weathering of Yellow Paint.** Properly mix and apply yellow paint at 250 microns  $\pm$  50 microns (10 mils  $\pm$  2 mils) DFT over a suitably sized, clean aluminum substrate (ASTM-D-823), and cure for a minimum of 48 hours: four individual yellow samples shall be prepared. Expose three samples to continuous Ultraviolet (UV) light for 2500 hours, without cycled condensation, in accordance to ASTM-G-53: UVA-340 lamps shall be used in the testing apparatus. Following exposure, compare the three exposed samples to the "one" non-exposed sample using Fed. Std. 595B colors 33538 and 33655 as visual references: evaluate exposed samples for degree of visual color loss. Yellow paint shall receive a passing rating if each

exposed sample appears visually equivalent to the non-exposed sample and, in addition, displays color loss no greater than Fed. Std. 595B color 33655.

**3.3 Material Safety Data Sheet (MSDS).** The manufacturer shall comply with the requirements set forth by the Hazardous Communication Standard 29 CFR 1910.1200 (d) through (g). All MSDSs submitted shall comply with FED-STD-313.

#### **4. REGULATORY REQUIREMENTS.**

**4.1 Federal Acquisition Regulations (FAR).** The offeror/contractor is encouraged to use recovered materials to the maximum extent practicable, in accordance with paragraph 23.403 of the FAR.

#### **5. QUALITY ASSURANCE PROVISIONS.**

**5.1 Contractor Quality Assurance.** The contractor shall maintain substantiating evidence that the product offered meets the salient characteristics of this CID and that the product conforms to the manufacturer's own specifications, standards, and quality assurance practices, and is the same product offered for sale in the commercial marketplace. Substantiating evidence shall include independent laboratory test results that are no more than 3 years old.

The contractor shall provide the required information in a tabulated format and with enough clarity so that the formulation of the tested product can be traced compared to the offered product(s). The contractor shall also provide a summary of performance data, consisting of test reports, substantiating that the product to be supplied under this CID meets the ASTM documents and paragraph numbers cited in Table 1, and is the same product offered for sale in the commercial marketplace.

The government reserves the right to require proof of such conformance prior to first delivery and thereafter as may be otherwise provided for under the provisions of the contract.

**5.2 Market Acceptability.** The following market acceptability criteria is necessary to document the quality of the coating to be provided under this CID:

- a. The company manufacturing the coating must have been producing a paint meeting the requirements of this CID for at least 1 year.
- b. The company must have sold a minimum of 1,000 gallons of paint meeting this CID in the commercial marketplace and over the past 1 year.

#### **6. PACKAGING.**

Preservation, packing, and marking shall be as specified in the contract or order.

#### **7. NOTES.**

**7.1 Intended Uses.** This section contains general coating guidance and does not address issues associated with safety, health, environmental regulations, specialty procedures, and all other pertinent information required to design a complete coating specification.

**7.1.1 Unsuitable Uses.** This CID **should not be used** to mark the following surfaces: A) Airfield pavements, B) Pavements with snowplow use (optional), and C) Pavement surfaces where water ponds for greater than 24 hours.

**7.1.2 Overcoating Existing Marking Paints.** This CID may be used to overcoat sound acrylic marking paints with no more than 40 mils of built-up paint. When tested for adhesion (ASTM-D-4541), a sound marking paint may exhibit either greater than 140 psi adhesion or produce 100 %

cohesive failures within the substrate. Overcoating is generally required when less than 77 % of the marking paint covers the substrate (ASTM-D-913). Apply in accordance with manufacturer's instructions.

**7.1.3 Coating Concrete.** New concrete may require a cure period of 60 days, or more, prior to the application of the acrylic marking paint. Remove unsound coatings, curing compounds, laitance, efflorescence, biological growth (mildew, fungus), dirt, oils, chalk, dust, and chloride salt contamination. Resulting surfaces shall contain sound coatings with a dull appearance and a sound substrate. On uncoated concrete, light shot blasting to a profile equal to ICRI-CSP 3 enhances marking paint performance and is highly recommended. Apply in accordance with manufacturer's recommendations.

**7.1.4 Coating Asphaltic Surfaces.** Remove unsound coatings, biological growth (mildew, fungus), dirt, oils, chalk, dust, and chloride salt contamination. Resulting surfaces shall contain sound coatings with a dull appearance and a sound substrate. On new asphaltic surfaces, two coats at half the normal application thickness and with a waiting period of several weeks between coats, may be required to reduce surface cracking, paint curling, and coating discoloration. To reduce rust bleed from asphaltic concrete containing iron sulfide aggregate, two coats at half the normal thickness, with a waiting period from one to several days between coats, may be required. Apply in accordance with manufacturer's recommendations.

**7.2 Ordering Data.** Purchasers should include the following information in the contract or purchase order.

- (a) Title, number, and date of this Commercial Item Description
- (b) Quantity of paint and size of the containers required
- (c) Color required
- (d) Address to whom MSDS should be sent
- (e) Packaging, packing, and marking required

**7.3 Part Identification Number (PIN).** The following part identification numbering procedure is for government purposes and does not constitute a requirement for the contractor.

AA\_\_\_\_\_-

#### **7.4 Referenced Documents.**

##### **Federal Specifications:**

FED-STD-313	Material Safety Data, Transportation Data and Disposal Data for Hazardous Materials Furnished to Government Activities
FED-STD-595B	Colors used in Government Procurement
TT-B-1325C	Beads (Glass Spheres) Retro-Reflective

##### **ASTM Standards:**

D-471	Standard Test Method for Rubber Property-Effect of Liquids
D-522	Standard Test Methods for Mandrel Bend Test of Attached Organic Coatings
D-711	No-Pick-Up Time of Traffic Paint
D-823	Standard Practice for Producing Films of Uniform Thickness of Paints, Varnishes, and Related Products on Test Panels
D-913	Standard Test Method for Evaluating Degree of Resistance to Wear of Traffic Paint
D-2240	Standard Test Method for Rubber Property-Durometer Hardness

- D-2697 Standard Test Method for Volume Nonvolatile Matter in Clear or Pigmented Coatings
- D-3335 Low Concentrations of Lead, Cadmium, and Cobalt in Paint by Atomic Absorption Spectroscopy
- D-3624 Low Concentrations of Mercury in Paint by Atomic Absorption Spectroscopy
- D-3718 Low Concentrations of Chromium in Paint by Atomic Absorption Spectroscopy
- D-3924 Standard Environment for Conditioning and Testing Paint, Varnish, Lacquers, and Related Materials
- D-3960 Standard Practice for Determining Volatile Organic Compound (VOC) Content of Paints and Related Coatings
- D-4541 Standard Test Method for Pull-Off Strength of Coatings Using Portable Adhesion Testers
- G-53 Standard Practice for Operating Light- and Water-Exposure Apparatus (Fluorescent UV-Condensation Type) for Exposure of Nonmetallic Materials

## INTERNATIONAL CONCRETE REPAIR INSTITUTE

ICRI Guideline 03732      Selecting and Specifying Concrete Surface Preparation  
For Sealers, Coatings, and Polymer Overlays

### 7.5 Source of Documents.

7.5.1 Contact the contracting officer for a copy of paragraph 23.403 of the FAR, and the appropriate paragraphs in 29 and 40 CFR.

7.5.2 Copies of ASTM specifications and standards may be obtained from the American Society for Testing and Materials, 100 Barr Harbor Drive, West Conshohocken, PA 19428-2959. Copies of Federal Standards and Military Specifications may be obtained from the Defense Automation and Production Service, Building 4/D, 700 Robbins Avenue, Philadelphia, PA 19111 – 5094. Copies of ICRI Guidelines may be obtained from the International Concrete Repair Institute, 1323 Shepard Drive, Suite D, Sterling, VA 21064.

### 7.6 Partial List of High Build Acrylic Coatings.

#### 7.6.1 Products.

Products	Manufacturer
Pervo 6050, White	Pervo Paints
UC-1516, White	Vogel Traffic Services
Legend Build, #2712A9, White	TMT-Pathways
Pervo 6053, Yellow	Pervo Paints
UC-3588, Yellow	Vogel Traffic Services
Legend Build, #2713A9, Yellow	TMT-Pathways

#### 7.6.2 Manufacturer Contact Information.

Pervo Paints  
6624 Stanford Ave.  
Los Angeles, CA 90001  
(323) 758 - 1147

Vogel Traffic Services  
1920 Albany Place South  
PO Box 140  
Orange City, IA 51041  
(712) 737 - 4016

TMT-Pathway  
1021 N. Mission Road  
Los Angeles, CA 90033  
(800) 338 – 7680

**APPENDIX D**

**AMENDMENTS**

**NFGS-02761E “PAVEMENT MARKINGS”**

\*\*\*\*\*  
DEPARTMENT OF THE NAVY NFGS-02761F  
NAVAL FACILITIES 30 September 2000  
ENGINEERING COMMAND -----  
GUIDE SPECIFICATION Superseding NFGS-02761E  
(09/98)  
\*\*\*\*\*

## SECTION 02761

### PAVEMENT MARKINGS 08/00

\*\*\*\*\*

NOTE: This guide specification covers new markings and remarking requirements for airfields, roads, streets, and parking areas by means of painting. Where curbs, obstructions, and other appurtenant structures are included in the work, the same general requirements will apply but hand application with pneumatic spray guns will be used in these areas.

Criteria and standard requirements for pavement markings are provided in the following publications:

#### 1. American National Standards Institute (ANSI)

D6.1d-1986 - Uniform Traffic Control Devices for Streets and Highways

#### 2. Naval Air System Command Publication:

NAVAIR 51-50AAA-2 - Shorebased Airfield Marking and Lighting.

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NOTE: This revision "E" to NFGS-02761 amends the issue dated 30 September 1998 by revising the submittal article to comply with the agreement reached by the SPECSINTACT Tri-Agency Committee and paragraphs as indicated by change tags.

\*\*\*\*\*

\*\*\*\*\*

NOTE: On the project drawings, show location, width, type, and color of the paint markings to be used.

\*\*\*\*\*

\*\*\*\*\*

NOTE: When the use of pavement marking materials (epoxy, thermoplastic, and preformed) which perform better than paint is desired for new pavement in Virginia and North Carolina, contact LANTNAVFACENGCOM for sample section.

\*\*\*\*\*

## PART 1 GENERAL

### 1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by the basic designation only.

#### AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM D 471	(1998) Standard Test for Rubber Property- Effect of Liquids
ASTM D 522	(1993) Standard Test Methods for Mandrel Bend Test of Attached Organic Coatings
ASTM D 711	(1998) No-Pick-Up Time of Traffic Paint
ASTM D 792	(1991) Density and Specific Gravity (Relative Density) of Plastics by Displacement
ASTM D 823	(1995) Standard Practice for Producing Films of Uniform Thickness of Paints, Varnishes, and Related Products on Test Panels
ASTM D 913	(1993) Standard Test Method for Evaluating Degree of Resistance to Wear of Traffic Paint
ASTM D 2240	(1997) Standard Test Method for Rubber Property-Durometer Hardness
ASTM D 2621	(1995) Standard Test Method for Infrared Identification of Vehicle Solids from Solvent-Reducible Paints
ASTM D 2697	(1998) Standard Test Method for Volume Nonvolatile Matter in Clear or Pigmented Coatings
ASTM D 3335	(1999) Low Concentrations of Lead, Cadmium, and Cobalt in Paint by Atomic Absorption Spectroscopy
ASTM D 3624	(1999) Low Concentrations of Mercury in Paint by Atomic Absorption Spectroscopy
ASTM D 3718	(1999) Low Concentrations of Chromium in Paint by Atomic Absorption Spectroscopy

ASTM D 3924	(1996) Standard Environment for Conditioning and Testing Paint, Varnish, Lacquers, and Related Materials
ASTM D 3960	(1998) Standard Practice for Determining Volatile Organic Compound (VOC) Content of Paints and Related Coatings
ASTM D 4280	(1996) Extended Life Type, Nonplowables, Prismatic, Raised, Retroreflective Pavement Markers
ASTM D 4541	(1995) Standard Test Method for Pull-Off Strength of Coatings Using Portable Adhesion Testers
ASTM E 28	(1996) Softening Point by Ring-and-Ball Apparatus
ASTM G 53	(1996) Standard Practice for Operating Light- and Water-Exposure Apparatus (Fluorescent UV-Condensation Type) for Exposure of Nonmetallic Materials

#### COMMERCIAL ITEM DESCRIPTIONS (CID)

CID A-A-2886 Paint, Traffic, Solvent Based

#### FEDERAL SPECIFICATIONS (FS)

FS TT-P-115 (Rev. F) Paint, Traffic (Highway, White and Yellow)

FS TT-B-1325 (Rev. C) Beads (Glass Spheres) Retro-Reflective

FS TT-P-1952 (Rev. D) Paint, Traffic and Airfield Markings, Water Emulsion Base

#### INTERNATIONAL CONCRETE REPAIR INSTITUTE

ICRI Guideline 03732 Selecting and Specifying Concrete Surface Preparation For Sealers, Coatings, and Polymer Overlays

#### 1.2 SUBMITTALS

\*\*\*\*\*

NOTE: Where a "G" in submittal tags follows a submittal item, it indicates Government approval for that item. Add "G" in submittal tags following any added or existing submittal items deemed sufficiently critical, complex, or aesthetically significantly to merit approval by the Government. Submittal items not designated with a "G" will be approved by the QC organization.

\*\*\*\*\*

Submit the following in accordance with Section 01330, "Submittal Procedures."

SD-03 Product Data

Reflective media for airfields

Reflective media for roads and streets

Paints for airfields

Paints for roads and streets

High Build Acrylic Coating (HBAC); G

Thermoplastic compounds and primer

Raised Pavement Markers and Adhesive

SD-06 Test Reports

Reflective media for airfields

Reflective media for roads and streets

Paints for airfields

Paints for roads and streets

High Build Acrylic Coating (HBAC); G

Thermoplastic compounds and primer

Raised Pavement Markers and Adhesive

Report from sampling and testing made in accordance with paragraph entitled "Sampling and Testing."

SD-07 Certificates

Reflective media for airfields

Reflective media for roads and streets

Paints for airfields

Paints for roads and streets

Thermoplastic compounds and primer

Construction equipment list

SD-08 Manufacturer's Instructions

Paints for airfields

Paints for roads and streets

Thermoplastic compounds and primer

Submit manufacturer's Material Safety Data Sheets.

### 1.3 DELIVERY AND STORAGE

Deliver paints, paint materials and thermoplastic compound materials in original sealed containers that plainly show the designated name, specification number, batch number, color, date of manufacture, manufacturer's directions, and name of manufacturer. Provide storage facilities at the job site for maintaining materials at temperatures recommended by the manufacturer. [Make available paint stored at the project site or segregated at the source for sampling not less than 30 days prior to date of required approval for use to allow sufficient time for testing. Notify the Contracting Officer when paint is available for sampling.]

### 1.4 WEATHER LIMITATIONS

\*\*\*\*\*  
NOTE: If emergency marking at temperatures from  
- 1 degrees C 30 degrees F to 5 degrees C 40  
degrees F is required, the Air Force's  
Engineering Technical Letter (ETL) 97-16  
"Pavement Marking System for Low Temperature  
Applications" may be used. Special approval is  
required prior to use on all airfield pavements.  
\*\*\*\*\*

Apply paint to clean, dry surfaces, and unless otherwise approved, only when air and pavement temperatures are above 5 degrees C 40 degrees F for oil-based materials, 10 degrees C 50 degrees F for water-based materials, and rising, and less than 35 degrees C 95 degrees F. Water-based materials can be applied at temperatures up to 46 degrees C 115 degrees F. Maintain paint temperature within these same limits.

### 1.5 EQUIPMENT

\*\*\*\*\*  
NOTE: Where pavement marking is limited to  
small street and parking areas, use first  
paragraph entitled "Paint Applicator."  
\*\*\*\*\*

Machines, tools, and equipment used in the performance of the work shall be approved by the Contracting Officer and maintained in satisfactory operating condition. Submit construction equipment list approval by the Contracting Officer.

#### 1.5.1 Paint Applicator

\*\*\*\*\*  
NOTE: Select the applicable paragraph(s) from  
the following:  
\*\*\*\*\*

[Provide hand-operated push-type applicator machine of a type commonly used for application of paint to pavement surfaces. Paint applicator

machine shall be acceptable for marking small street and parking areas. Applicator machine shall be equipped with the necessary paint tanks and spraying nozzles, and shall be capable of applying paint uniformly at coverage specified. Application equipment for water-based markings shall contain teflon hoses, or equal, and metal parts in contact with paint shall be stainless steel of grade 302, 304, or 316, or equal.]

[Provide self-propelled or mobile-drawn pneumatic spraying machine with suitable arrangements of atomizing nozzles and controls to obtain the specified results. Provide machine having a speed during application capable of applying the stripe widths indicated at the paint coverage rate specified herein and of even uniform thickness with clear-cut edges. [Provide equipment used for marking streets and highways capable of placing the prescribed number of lines at a single pass as solid lines, intermittent lines, or a combination of solid and intermittent lines using a maximum of three different colors of paint as specified.] [The equipment for applying the paint for airfield pavements will be a self-propelled or mobile-drawn pneumatic spraying machine with an arrangement of atomizing nozzles capable of applying a width of line at any one time in multiples of 150 mm 6 inches, from 150 to 900 mm 6 to 36 inches.] Provide paint applicator with paint reservoirs or tanks of sufficient capacity and suitable gages to apply paint in accordance with requirements specified. Equip tanks with suitable air-driven mechanical agitators. Equip spray mechanism with quick-action valves conveniently located, and include necessary pressure regulators and gages in full view and reach of the operator. Install paint strainers in paint supply lines to ensure freedom from residue and foreign matter that may cause malfunction of the spray guns. The paint applicator shall be readily adaptable for attachment of an air-actuated dispenser for the reflective media approved for use. Provide pneumatic spray guns for hand application of paint in areas where the mobile paint applicator cannot be used. Application equipment for water-based markings shall contain teflon hoses, or equal, and metal parts in contact with paint shall be stainless steel of grade 302, 304, or 316, or equal.]

#### 1.5.2 Reflective Media Dispenser

Attach dispenser for applying the reflective media to the paint dispenser and operate automatically and simultaneously with the paint applicator through the same control mechanism. Use dispenser capable of adjustment and designed to provide uniform flow of reflective media over the full width of the stripe at the rate of coverage specified herein at all operating speeds of the paint applicator to which it is attached.

#### 1.5.3 Thermoplastic Application Equipment

Application equipment shall be mobile and maneuverable to the extent that straight lines can be followed and normal curves can be made in a true arc. The equipment used for the placement of thermoplastic pavement markings shall be of two general types: mobile applicator and portable applicator.

#### 1.5.3.1 Mobile Application Equipment

The mobile applicator shall be defined as a truck-mounted, self-contained pavement marking machine that is capable of hot applying thermoplastic by either the extrusion or spray method. The mobile unit shall be capable of operating continuously and of installing a minimum of 6000 mm 20,000 lineal feet of longitudinal markings in a 8-hour day. Equip the mobile unit with a melting kettle of such capacity as to hold a minimum of 2700 kg 6000 pounds of molten thermoplastic material. The kettle shall be capable of heating the thermoplastic composition to temperatures of 190 to 218 degrees C 375 to 425 degrees F. The heating mechanism shall be by means of a thermostatically controlled heat transfer liquid. Heating of the composition by direct flame shall not be allowed. Oil and material temperature gages shall be visible at both ends of the kettle. [Equip the mobile unit with a minimum of two extrusion shoes located one on each side of the truck, and shall be capable of marking simultaneous edgeline and centerline stripes. Each extrusion shoe shall be a closed, oil-jacketed unit; shall hold the molten thermoplastic at a temperature of 190 to 218 degrees C 375 to 425 degrees F; and shall be capable of extruding a line of 75 to 200 mm 3 to 8 inches in width; and at a thickness of not less than 3 mm 0.125 inch nor more than 5 mm 0.190 inch, and of generally uniform cross section.] [Equip the mobile unit with a spray gun system. The spray system shall consist of a minimum of four spray guns, located two on each side of the truck, and shall be capable of marking simultaneous edgeline and centerline stripes. Surround the spray system (jacketed) with heating oil so as to maintain the molten thermoplastic at a temperature of 190 to 218 degrees C 375 to 425 degrees F; and shall be capable of spraying a stripe of 75 to 300 mm 3 to 12 inches in width, and in thickness varying from 1.5 to 2.5 mm 0.055 to 0.095 inch, and of generally uniform cross section.]

#### 1.5.3.2 Portable Application Equipment

The portable applicator shall be defined as hand-operated equipment, specifically designed for placing special markings such as crosswalks, stopbars, legends, arrows, and short lengths of lane, edge and centerlines. The portable applicator shall be capable of applying thermoplastic pavement markings by the extrusion method. It is intended that the portable applicator will be loaded with hot thermoplastic composition from the melting kettles on the mobile applicator. Equip the portable applicator with all the necessary components, including a materials storage reservoir, bead dispenser, extrusion shoe, and heating accessories, so as to be capable of holding the molten thermoplastic at a temperature of 190 to 218 degrees C 375 to 425 degrees F, of extruding a line of 75 to 300 mm 3 to 12 inches in width, and in thickness of not less than 3 mm nor more than 5 mm 0.125 inch nor more than 0.190 inch and of generally uniform cross section.

### PART 2 PRODUCTS

#### 2.1 MATERIALS

\*\*\*\*\*

**NOTE: Use either FS TT-P-1952, a water-emulsion marking paint, or the High Build Acrylic Coating (HBAC) on asphaltic pavements and pavements in**

areas where air pollution by organic solvents is a problem. On concrete pavements where air pollution by organic solvents is not a problem, FS TT-P-1952 or CID A-A-2886 paint may be used.

The HBAC is suitable for use either alone or to bind reflective beads and can be applied at two to three times the thickness of conventional marking paints. The paint produces slightly upraised markings and is appropriate for use in marking crosswalk bars, stop bars, railroad crossings, lettering, centerlines, skip lines, and edge lines. At this time, the HBAC is not intended for use on airfield pavements.

FS TT-P-115 is for general use. Use Type I where relatively slow drying can be tolerated and bleeding is a problem. Use Type II for fast drying where bleeding is no problem. Fast drying tends to be less flexible and more brittle.

Use either the HBAC or thermoplastic markings to reduce maintenance costs in the desert areas, where painted markings are susceptible to a "sandblasting" effect during high winds.

\*\*\*\*\*

Provide materials conforming to the requirements specified herein.

\*\*\*\*\*

NOTE: For LANTNAVFACENGCOM projects only. When the use of pavement marking materials (epoxy, thermoplastic, and preformed) which perform better than paint is desired for new pavement in Virginia and North Carolina, contact LANTNAVFACENGCOM for sample section.

\*\*\*\*\*

#### 2.1.1 Paints for Airfields

[CID A-A-2886] [FS TT-P-1952], color as [indicated] [selected].

#### 2.1.2 Paints for Roads and Streets

[CID A-A-2886] [FS TT-P-1952] [High Build Acrylic Coating (HBAC)] [FS TT-P-115] [FS TT-P-1952], color as [indicated] [selected].

#### 2.1.3 Reflective Media for Airfields

FS TT-B-1325, Type III, Gradation [A] [B].

#### 2.1.4 Reflective Media for Roads and Streets

FS TT-B-1325, Type [I] [II], Gradation A.

### 2.1.5 Thermoplastic Compounds

The thermoplastic reflectorized pavement marking compound shall be extruded or sprayed in a molten state onto a primed pavement surface. Following a surface application of glass beads and upon cooling to normal pavement temperatures, the marking shall be an adherent reflectorized strip of the specified thickness and width that is capable of resisting deformation by traffic.

#### 2.1.5.1 Composition Requirements

The binder component shall be formulated as a hydrocarbon resin. The pigment, beads and filler shall be uniformly dispersed in the binder resin. The thermoplastic composition shall be free from all skins, dirt, and foreign objects and shall comply with the following requirements:

<u>Component</u>	<u>Percent by Weight</u>	
	<u>White</u>	<u>Yellow</u>
Binder	17 min	17 min
Titanium dioxide	10 min	-
Glass beads	20 min	20 min
Calcium carbonate and inert fillers	49 min	*
Yellow pigments	-	*

\*Amount and type of yellow pigment, calcium carbonate and inert fillers shall be at the option of the manufacturer, providing the other composition requirements of this specification are met.

#### 2.1.5.2 Physical Properties

- a. Drying time: When installed at 21 degrees C 70 degrees F and in thicknesses between 3 and 5 mm 1/8 and 3/16 inch, the composition shall be completely solid and shall show no damaging effect from traffic after curing 15 minutes.
- b. Softening point: The composition shall have a softening point of not less than 90 degrees C 194 degrees F when tested in accordance with ASTM E 28.
- c. Specific gravity: The specific gravity of the composition shall be between 1.9 and 2.2 as determined in accordance with ASTM D 792.

#### 2.1.5.3 Primer

- a. Asphalt concrete primer: The primer for asphalt concrete pavements shall be a thermosetting adhesive with a solids content of pigment reinforced synthetic rubber and synthetic plastic resin dissolved or dispersed in a volatile organic solvent. The solids content shall not be less than 10 percent by weight at 21 degrees C 70 degrees F and 60 percent relative humidity. A wet film thickness of 0.13 mm 0.005 inch, plus or minus 0.03 mm 0.001 inch, shall dry to a tack-free condition in less than 5 minutes.

- b. Portland cement concrete primer: The primer for portland cement concrete pavements shall be an epoxy resin primer. The primer shall be of the type recommended by the manufacturer of the thermoplastic composition.

#### 2.1.6 Raised Pavement Markers

Either metallic or nonmetallic markers of the button or prismatic reflector type may be used. Markers shall be of permanent colors as specified for pavement marking, and shall retain the color and brightness under the action of traffic. Button markers shall have a diameter of not less than 100 mm 4 inches. Button markers shall have rounded surfaces presenting a smooth contour to traffic and shall not project more than 3/4 inch above level of pavement. Pavement markers and adhesive epoxy shall conform to ASTM D 4280.

#### 2.1.7 High Build Acrylic Coating (HBAC)

The High Build Acrylic Coating (HBAC) shall be formulated to meet the requirements of Table I. Presented in Table II, is a partial list of commercially available HBACs.

### PART 3 EXECUTION

#### 3.1 SURFACE PREPARATION

\*\*\*\*\*

NOTE: Newly laid flexible and rigid pavements require aging prior to painting in order to obtain satisfactory paint performance. If practicable, all new pavement surfaces should be at least 30 days old before application of marking materials. When earlier application of paint is necessary because of operations requirements, the maximum period practicable should be specified.

Removal of rubber is generally accomplished by water blasting. Few approved chemical are effective and sandblasting is not permitted by air pollution regulations at some locations. Mechanical abrasion generally causes damage to the pavement.

Detailed procedures for conducting rubber and paint removal from airfield pavements are contained in Section 02981, "Rubber and Paint Removal from Airfield Pavements." Use of shot blasting on airfield pavements is prohibited.

Overcoating is generally required when less than 77 % of marking paint covers pavement (ASTM-D-913), loss of glass beads effects night visibility, and fading affects marking paint identification. Existing marking paints with paint build-up greater than 1 mm 40 mils shall be completely removed in accordance with Section 02981, unless crack free and determined sound. When tested for adhesion (ASTM-D-4541), a sound marking paint may exhibit greater than

140 psi adhesion and/or produce 100 % cohesive failures within the pavement.

\*\*\*\*\*

Allow new pavement surfaces to cure for a period of not less than [30] [ ] days before application of marking materials. Thoroughly clean surfaces to be marked before application of the paint. Remove dust, dirt, and other granular surface deposits by sweeping, blowing with compressed air, rinsing with water, or a combination of these methods as required. Remove [rubber deposits,] [existing paint markings,] [residual curing compounds,] and other coatings adhering to the pavement by waterblasting. In addition to waterblasting, sanding/grinding, light shot blasting, and light scarification, to a resulting level of coarseness equal to ICRI-CSP 2, ICRI-CSP 3, and ICRI-CSP 4, respectively, can be used to either remove existing coatings or for surface preparation on most pavements. Shot blasting is prohibited on all airfield pavements due to the potential of Foreign Object Damage (FOD) to aircraft. Scrub affected areas, where oil or grease is present on old pavements to be marked, with several applications of trisodium phosphate solution or other approved detergent or degreaser and rinse thoroughly after each application. After cleaning oil-soaked areas, seal with shellac or primer recommended by the manufacturer to prevent bleeding through the new paint. Do not commence painting in any area until pavement surfaces are dry and clean.

### 3.2 APPLICATION

#### 3.2.1 Rate of Application

\*\*\*\*\*

NOTE: On new asphaltic surfaces, two coats of marking paint at half the normal application thickness and with a waiting period of several weeks between coats may be required. This practice can reduce surface cracking, paint curling, and marking paint discoloration.

\*\*\*\*\*

##### 3.2.1.1 Reflective Markings

Apply paint evenly to the pavement area to be coated at a rate of 2.5 plus or minus 0.10 square meter per liter 105 plus or minus 5 square feet per gallon. The High Build Acrylic Coating (HBAC) shall be applied as a double stripe in "two consecutive full coats." Apply glass spheres uniformly to the wet paint [on airfield pavement at a rate of (1198)] [on road and street pavement at a rate of (719)] plus or minus (60) kg of glass spheres per cubic meter [on airfield pavement at a rate of (10)] [on road and street pavement at a rate of (6)] plus or minus (0.5) pounds of glass spheres per gallon.

##### 3.2.1.2 Nonreflective Markings

Apply paint evenly to the pavement surface to be coated at a rate of 2.5 plus or minus 0.10 square meter per liter 105 plus or minus 5 square feet per gallon. The High Build Acrylic Coating (HBAC) shall be applied as a double stripe in "two consecutive full coats."

### 3.2.1.3 Thermoplastic Compound

After surface preparation has been completed, prime the asphalt or concrete pavement surface with spray equipment. Allow primer materials to "set-up" prior to applying the thermoplastic composition. [Allow the asphalt concrete primer to dry to a tack-free condition, usually occurring in less than 10 minutes.] [Allow the portland cement concrete primer to dry in accordance with the thermoplastic manufacturer recommendations. To shorten the curing time of the epoxy resins, an infrared heating device may be used on the concrete primer.] [Apply asphalt concrete primer to all asphalt concrete pavements at a wet film thickness of 0.13 mm 0.005 inch, plus or minus 0.03 mm 0.001 inch 6.5 to 10.0 square meters per liter 265 to 400 square feet per gallon.] [Apply portland cement concrete primer to all concrete pavements (including concrete bridge decks) at a wet film thickness of between 1.0 to 1.3 mm 0.04 to 0.05 inch 7.8 to 10.0 square meters per liter 320 to 400 square feet per gallon.] After the primer has "set-up", apply the thermoplastic at temperatures no lower than 191 degrees C 375 degrees F nor higher than 218 degrees C 425 degrees F at the point of deposition. Immediately after installation of the marking, apply drop-on reflective glass spheres mechanically at the rate of 0.24 kg per square meter one pound per 20 square feet such that the spheres are held by and imbedded in the surface of the molten material. Apply all extruded thermoplastic markings at the specified width and at a thickness of not less than 3 mm 0.125 inch nor more than 5 mm 0.190 inch. Apply all sprayed thermoplastic markings at the specified width and the thickness designated in the contract plans. If the plans do not specify a thickness, apply centerline markings at a wet thickness of 2.3 mm 0.090 inch, plus or minus 0.13 mm 0.005 inch, and edgeline markings at a wet thickness of 1.5 mm 0.060 inch, plus or minus 0.13 mm 0.005 inch.

### 3.2.2 Painting

Apply paint pneumatically with approved equipment at rate of coverage specified herein. Provide guidelines and templates as necessary to control paint application. Take special precautions in marking numbers, letters, and symbols. Manually paint numbers, letters, and symbols. Sharply outline all edges of markings. The maximum drying time requirements of the paint specifications will be strictly enforced, to prevent undue softening of bitumen, and pickup, displacement, or discoloration by tires of traffic. Discontinue painting operations if there is a deficiency in drying of the markings until cause of the slow drying is determined and corrected.

### 3.2.3 Reflective Media

Application of reflective media shall immediately follow the application of paint. Accomplish drop-on application of the glass spheres to ensure even distribution at the specified rate of coverage. Should there be malfunction of either paint applicator or reflective media dispenser, discontinue operations until deficiency is corrected.

### 3.2.4 Thermoplastic Compound

Place thermoplastic pavement markings upon dry pavement. At the time of installation the pavement surface temperature shall be a minimum of 5 degrees C 40 degrees F and rising. Thermoplastics, as placed, shall

be free from dirt or tint. Apply all centerline, skipline, edgeline, and other longitudinal type markings with a mobile applicator. Place all special markings, crosswalks, stop bars, legends, arrows, and similar patterns with a portable applicator, using the extrusion method.

### 3.2.5 Raised Pavement Markers

Prefabricated markers shall be aligned carefully at the required spacing or as directed and permanently fixed in place by means of epoxy adhesives. To ensure good bond, areas where markers will be set shall be thoroughly cleaned by water blasting and use of compressed air prior to applying adhesive.

## 3.3 FIELD TESTING AND INSPECTION

### 3.3.1 Sampling and Testing

\*\*\*\*\*

NOTE: The material specifications do not provide for obtaining certified production data, and the importance of verification testing for each batch where appreciable quantities are involved is emphasized. Only when the factors of time, value of material, and its application versus cost of testing and end use of the material justify a waiver of testing will certification be acceptable.

For projects 3500 square meters 4000 square yards in painted surface area, requirements for Contractor's testing should be used. For small projects, use Government test option.

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As soon as the paint [and reflective] [and thermoplastic] materials are available for sampling, obtain by random selection from the sealed containers, two quart samples of each batch in the presence of the Contracting Officer. Accomplish adequate mixing prior to sampling to ensure a uniform, representative sample. A batch is defined as that quantity of material processed by the manufacturer at one time and identified by number on the label. Clearly identify samples by designated name, specification number, batch number, project contract number, intended use, and quantity involved. [Test samples by an approved laboratory. If a sample fails to meet specification, replace the material in the area represented by the samples and retest the replacement material as specified above. Submit copy of the test results to the Contracting Officer. Include in the report of test results a listing of any specification requirements not verified by the test laboratory.] [At the discretion of the Contracting Officer, additional samples provided may be tested by the Government for verification.]

### 3.3.2 Inspection

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NOTE: The material specifications do not provide for obtaining certified production data, and the importance of verification testing for each batch where appreciable quantities are

involved is emphasized. Only when the factors of time, value of material, and its application versus cost of testing and end use of the material justify a waiver of testing will certification be acceptable.

For projects 3500 square meters 4000 square yards in painted surface area, requirements for Contractor's testing should be used. For small projects, use Government test option.

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Examine material at the job site to determine that it is the material referenced in the report of test results or certificate of compliance. A certificate of compliance shall be accompanied by test results substantiating conformance to the specified requirements.

#### 3.3.2.1 Surface Preparations and Application Procedures

Surface preparations and application procedures will be examined by the Contracting Officer to determine conformance with the requirements specified. Approve each separate operation prior to initiation of subsequent operations.

#### 3.4 TRAFFIC CONTROL AND PROTECTION

Place warning signs near the beginning of the work site and well ahead of the work site for alerting approaching traffic from both directions. Place small markers along newly painted lines to control traffic and prevent damage to newly painted surfaces. Mark painting equipment with large warning signs indicating slow-moving painting equipment in operation.

**TABLE I**  
**REQUIREMENTS FOR HIGH BUILD ACRYLIC COATINGS (HBAC)**

Test	Minimum Requirement (and Maximum where indicated)
Resin System (ASTM-D-2621)	Waterborne 100 % Acrylic
Percent Volume Solids (ASTM-D-2697)	58 %
Volatile Organic Compound, max. (ASTM-D-3960)	150 g/l
White (Fed. Std. 595B)	37925
Yellow (Fed. Std. 595B)	33538
Shore D Hardness (ASTM-D-2240)	45
1/8" Mandrel Bend @ 5 mils Dry Film Thickness (DFT), one-week cure (ASTM-D-522, Method B)	No visual defects at bend (Conditions @ ASTM-D-3924)
Adhesion to Concrete and Asphaltic Pavements (ASTM-D-4541)	140 psi or 100 % cohesive failure in pavement
Accelerated Weathering, Yellow, 2500 Hours UV Exposure (ASTM-G-53: See Note 1)	Max. color loss to 33655 (Fed. Std. 595B)
Water Absorption @ 168 Hours Immersion Tap Water (ASTM-D-471)	9.0 % max. weight increase (Conditions @ ASTM-D-3924)
Application @ 65 mils Wet, One Coat, One-week Cure, (See Note 2)	No visual cracking or curling (Conditions @ ASTM-D-3924)
No Pick-Up @ 25 mils Wet (ASTM-D-711)	10 minutes max.
Lead (ASTM-D-3335)	0.06 % max.
Cadmium (ASTM-D-3335)	0.06 % max.
Chromium (ASTM-D-3718)	0.00 %

**NOTES:**

- (1) Properly mix and apply yellow paint at 250 microns  $\pm$  50 microns (10 mils  $\pm$  2 mils) DFT over a suitably sized, clean aluminum substrate (ASTM-D-823), and cure for a minimum of 48 hours: four individual yellow samples shall be prepared. Expose three samples to continuous Ultraviolet (UV) light for 2500 hours, without cycled condensation, in accordance to ASTM-G-53: UVA-340 lamps shall be used in the testing apparatus. Following exposure, compare the three exposed samples to the "one" non-exposed sample using Fed. Std. 595B colors 33538 and 33655 as visual references: evaluate exposed samples for degree of visual color loss. Yellow paint shall receive a passing rating if each exposed sample appears visually equivalent to the non-exposed sample and, in addition, displays color loss no greater than Fed. Std. 595B color 33655.

(2) Using 3M double-stick, foam mounting tape (or equal) with a nominal thickness of 1625 microns (65 mils), apply a rectangular mold with inner dimensions of 7.6 cm x 25.5 cm (3 in x 10 in) to a clean aluminum sample approximately sized at 15 cm x 30 cm x 0.30 cm (6 in x 12 in x 1/8 in). Do not remove the tape's plastic backing. Mix and apply excess paint into mold. Remove excess paint, by squeegee or other appropriate draw down technique, to a uniform thickness equal to the tape's height. Paint application and draw down shall be performed within a period of no more than 60 seconds. Approximately one to two minutes following draw down, remove tape from sample and allow coating to cure for a minimum period of one-week (ASTM-D-3924). Using a micrometer or other appropriate device, measure cured coating thickness (less sample thickness) to confirm resulting coating application was at or above 950 microns (38 mils) DFT. Inspect coating for visual signs of cracking and curling. Following a one-week cure, coating shall receive a passing rating if applied greater than 950 microns (38 mils) DFT and visually free of both cracking and curling.

TABLE II  
PARTIAL LIST OF COMMERCIALY AVAILABLE HBACs

Products	Manufacturer
Pervo 6050, White Pervo 6053, Yellow	Pervo Paints 6624 Stanford Ave. Los Angeles, CA 90001 (323) 758 - 1147
UC-1516, White UC-3588, Yellow	Vogel Traffic Services 1920 Albany Place South PO Box 140 Orange City, IA 51041 (712) 737 - 4016
Legend Build, #2712A9, White Legend Build, #2713A9, Yellow	TMT-Pathway 1021 N. Mission Road Los Angeles, CA 90033 (800) 338 - 7680

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NOTE: Suggestions for improvement of this specification will be welcomed using the Navy "Change Request Forms" subdirectory located in SPECSINTACT in Jobs or Masters under "Forms/Documents" directory or DD Form 1426. Suggestions should be forwarded to:

Officer In Charge  
Seabee Logistics Center  
NAVFAC 15G/SLC 46  
4111 San Pedro Street  
Port Hueneme, CA 93043-4410

FAX: (805) 985-6465/982-5196 or DSN 551-5196

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**APPENDIX E**

**SPECIFICATION**

**“HBAC FOR MARKING PAVEMENTS”**

# HIGH BUILD ACRYLIC COATING (HBAC) FOR MARKING PAVEMENTS\*\*

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## PART 1 GENERAL

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- 1.2 SUBMITTALS
- 1.3 DELIVERY AND STORAGE
- 1.4 WEATHER LIMITATIONS
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- 3.3 APPLICATION
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- 3.4 CURING
- 3.5 FIELD TESTING AND INSPECTION
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  - 3.5.2 Inspection
    - 3.5.2.1 Surface Preparation and Application Procedures

Table I: REQUIREMENTS FOR HIGH BUILD ACRYLIC COATINGS (HBAC)

Table II: PREAPPROVED HBACs

**\*\*USE OF THIS SPECIFICATION ON AIRFIELD PAVEMENTS IS PROHIBITED**

-- End of Section Table of Contents --

## PART 1 GENERAL

### 1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by the basic designation only.

#### AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM D 471	(1998) Standard Test for Rubber Property- Effect of Liquids
ASTM D 522	(1993) Standard Test Methods for Mandrel Bend Test of Attached Organic Coatings
ASTM D 711	(1998) No-Pick-Up Time of Traffic Paint
ASTM D 823	(1995) Standard Practice for Producing Films of Uniform Thickness of Paints, Varnishes, and Related Products on Test Panels
ASTM D 913	(1993) Standard Test Method for Evaluating Degree of Resistance to Wear of Traffic Paint
ASTM D 2240	(1997) Standard Test Method for Rubber Property-Durometer Hardness
ASTM D 2621	(1995) Standard Test Method for Infrared Identification of Vehicle Solids from Solvent-Reducible Paints
ASTM D 2697	(1998) Standard Test Method for Volume Nonvolatile Matter in Clear or Pigmented Coatings
ASTM D 3335	(1999) Low Concentrations of Lead, Cadmium, and Cobalt in Paint by Atomic Absorption Spectroscopy
ASTM D 3624	(1999) Low Concentrations of Mercury in Paint by Atomic Absorption Spectroscopy
ASTM D 3718	(1999) Low Concentrations of Chromium in Paint by Atomic Absorption Spectroscopy
ASTM D 3924	(1996) Standard Environment for Conditioning and Testing Paint, Varnish, Lacquers, and Related Materials
ASTM D 3960	(1998) Standard Practice for Determining Volatile Organic Compound (VOC) Content of Paints and Related Coatings
ASTM D 4541	(1995) Standard Test Method for Pull-Off Strength of Coatings Using Portable Adhesion Testers

ASTM G 53 (1996) Standard Practice for Operating  
Light- and Water-Exposure Apparatus  
(Fluorescent UV-Condensation Type) for  
Exposure of Nonmetallic Materials

FEDERAL SPECIFICATIONS (FS)

FS TT-B-1325 (Rev. C) Beads (Glass Spheres) Retro-Reflective

INTERNATIONAL CONCRETE REPAIR INSTITUTE

ICRI Guideline 03732 Selecting and Specifying Concrete Surface  
Preparation For Sealers, Coatings, and Polymer  
Overlays

1.2 SUBMITTALS

Submit the following in accordance with Section 01330, "Submittal  
Procedures."

SD-03 Product Data

High Build Acrylic Coating (HBAC);

SD-06 Test Reports

High Build Acrylic Coating (HBAC); G

Report from sampling and testing made in accordance with  
paragraph entitled "Sampling and Testing;"

SD-07 Certificates

Reflective media for roads and streets;

Construction equipment list; G

SD-08 Manufacturer's Instructions

High Build Acrylic Coating;

Material Safety Data Sheets (MSDS);

1.3 DELIVERY AND STORAGE

Deliver High Build Acrylic Coating (HBAC) in original sealed  
containers that clearly show, if applicable, the designated name,  
specification number, batch number, color, date of manufacture,  
manufacturer's directions, shelf-life expiration date, and name of  
manufacturer. Provide HBAC storage at the job site and maintain HBAC  
at temperatures from 10 degree C 50 degrees F to 26 degrees C 80  
degrees F. Materials on site shall be inspected for damage prior to  
use. Packaged materials in dented, rusty, or leaking containers shall  
be returned to manufacturer. Materials with an expired shelf life  
shall be returned to manufacture, tested, and if compliant, re-issued  
a shelf life extension.

#### 1.4 WEATHER LIMITATIONS

Apply HBAC to dry pavement, and unless otherwise approved, when air and pavement temperatures are above 10 degrees C 50 degrees F, and rising, and less than 46 degrees C 115 degrees F. Maintain temperature of HBAC within these same limits.

#### 1.5 EQUIPMENT

The Contracting Officer shall approve all machines, tools, and equipment for use in pavement marking. Submit construction equipment list for approval by the Contracting Officer.

##### 1.5.1 HBAC Applicator

- a. Provide hand-operated push-type HBAC applicator equipment. Equipment shall be appropriate for marking small streets and parking areas. Equipment shall be capable of producing stripes with clear-cut edges. Equipment shall contain HBAC tanks, spraying nozzles, and a spraying capability equal to the specified rate of coverage. Equipment shall contain teflon hoses, or equal, and metal parts in contact with HBAC shall be stainless steel of grade 302, 304, or 316, or equal.
- b. Provide self-propelled or mobile-drawn pneumatic spraying equipment with atomizing nozzles and controls to obtain the specified rate of coverage. Equipment shall be appropriate for use in marking streets, highways, and stripping numerous solid or skip lines in a single pass. Equipment shall be capable of producing stripes at various widths and with clear-cut edges. Equipment shall contain tanks with suitable air-driven mechanical agitators and pressure regulators with gages in full view/reach of equipment operator. Equipment shall be readily adaptable to attach air-actuated reflective glass bead dispenser(s). Strainer(s) shall be installed in supply lines to prevent residue and foreign matter from interfering with HBAC spraying. In areas where mobile HBAC applicator cannot be used, provide airless and/or conventional spray guns for hand application of HBAC. Equipment shall contain teflon hoses, or equal, and metal parts in contact with HBAC shall be stainless steel of grade 302, 304, or 316, or equal.

##### 1.5.2 Reflective Glass Bead Dispenser

Attach dispenser for application of reflective glass beads directly into wet HBAC. The dispenser shall be automatically controlled and operate in unison with the HBAC applicator. Use a dispenser capable of adjustment with design sufficient to provide a uniform flow of reflective glass beads over the full stripe width at the specified application rate.

## PART 2 PRODUCTS

### 2.1 MATERIALS

The High Build Acrylic Coating (HBAC) is suitable for use either alone or to bind reflective beads and can be applied in two to three consecutive applications to produce slightly upraised markings. HBAC is appropriate for use in marking crosswalk bars, stop bars, railroad

crossings, arrows, letters, centerlines, skip lines, and edge lines. At this time, HBAC shall not be used on airfield pavements.

#### 2.1.1 High Build Acrylic Coating (HBAC)

The HBAC shall be formulated to meet the requirements of Table I in either white or yellow. Presented in Table II, is a partial list of commercially available HBACs. Use either HBAC from Table II or submit test result and/or product data confirming HBAC meets the requirements of Table I.

#### 2.1.2 Reflective Glass Beads

FS TT-B-1325, Type I, Gradation A.

### PART 3 EXECUTION

#### 3.1 TRAFFIC CONTROL AND HBAC PROTECTION

Place warning signs near the beginning of work site and well ahead of work site to alert approaching traffic from both directions. During marking operations, install large warning signs on all application equipment to identify slow-moving vehicle(s). Place small markers along newly marked lines for use as traffic control and to prevent damage to newly marked surfaces. When marking at temperatures above 27 degrees C 80 degrees F, markers shall protect paint for a minimum of ten minutes. When marking at temperatures below 27 degree C 80 degrees F, markers shall protect paint for up to thirty minutes.

#### 3.2 SURFACE PREPARATION

##### 3.2.1 Concrete

New concrete can require a cure period of 60 days, or more, prior to the application of the HBAC. Remove unsound coatings, curing compounds, laitance, efflorescence, biological growth (mildew, fungus), dirt, oils, chalk, dust, and chloride salt contamination. Resulting surfaces are to contain sound coatings with a dull appearance and a sound substrate with surface coarseness no greater than ICRI-CSP 4. On uncoated concrete, light shot blasting to a level of coarseness equal to ICRI-CSP 3 and/or high-pressure water jetting enhances HBAC adhesion and is highly recommended.

##### 3.2.2 Asphaltic Wearing Surfaces

New asphaltic wearing surfaces can require a cure period of 30 days, or more, prior to the application of the HBAC. Remove unsound coatings, biological growth (mildew, fungus), dirt, oils, chalk, dust, and chloride salt contamination. Resulting surfaces are to contain sound coatings with a dull appearance and a sound substrate with surface coarseness no greater than ICRI-CSP 4. On uncoated asphaltic wearing surfaces, a pre-stripe is required prior to the full HBAC application.

##### 3.2.3 Coating Removal

Existing markings with paint build-up greater than 1 mm 40 mils shall be completely removed, unless crack free and determined sound. When

tested for adhesion (ASTM-D-4541), a sound marking paint may exhibit greater than 140 psi adhesion and/or produce 100 % cohesive failures within the pavement. Remove 100 % of unsound markings using a combination of grinding/sanding, light shot blasting, and light scarification, to a resulting level of coarseness equal to ICRI-CSP 2, ICRI-CSP 3, and ICRI-CSP 4, respectively.

#### 3.2.4 Overcoating

Overcoating is generally required when less than 77 % of marking paint covers pavement (ASTM-D-913), loss of glass beads effects night visibility, and fading affects marking paint identification. Remove unsound coatings, biological growth (mildew, fungus), dirt, oils, chalk, dust, and chloride salt contamination. Scuff sand all shinny/glossy markings to a dull appearance with visible scratches.

### 3.3 APPLICATION

Apply HBAC to dry and clean pavement surfaces. Newly laid asphaltic and concrete pavements require aging prior to the application of HBAC. If practical, all new pavement surfaces should cure a minimum of 30 days before HBAC application. When earlier application is required, the maximum cure period should be specified.

#### 3.3.1 Rate of Application

##### 3.3.1.1 Asphaltic Wearing Surfaces

On all uncoated asphaltic wearing surfaces, a pre-stripe of the HBAC shall be applied at a minimum of 250 square feet per gallon, 6.0 mils wet. The pre-stripe shall cure to a tack-free state prior to the full HBAC application. The pre-stripe is in addition to the application rates specified below. On new asphaltic surfaces, wait several weeks between HBAC pre-stripe and full HBAC application. This practice will reduce surface cracking, paint curling, and HBAC discoloration.

##### 3.3.1.2 Parking Lots

Apply HBAC at 110 square feet  $\pm$  5 square feet per gallon, 7.0 to 9.0 mils Dry Film Thickness (DFT). To rejuvenate existing markings, apply one coat at 145 square feet  $\pm$  5 square feet per gallon, 6.0 to 7.0 mils DFT.

##### 3.3.1.3 Centerlines, Edge Lines, Skip Lines

Apply HBAC at 50 square feet  $\pm$  5 square feet per gallon, 15.0 to 20.0 mils DFT. Apply reflective glass beads directly into wet HBAC at a uniform 6 pounds  $\pm$  0.5 pound per gallon applied HBAC.

##### 3.3.1.4 Crosswalk Bars, Stop Bars, Stop Words, Railroad Crossings, Arrows, Letters

Apply "three consecutive coats" of HBAC at 150 square feet  $\pm$  5 square feet per gallon, 6.0 mils DFT per application, to total 15.0 to 20.0 mils DFT. Apply reflective glass beads directly into the final HBAC application at a uniform 6 pounds  $\pm$  0.5 pound per gallon applied HBAC.

### 3.3.2 Marking

Apply HBAC with the equipment outlined in the Article entitled "EQUIPMENT." Employ guidelines and stencils as necessary to control HBAC application. Special precaution shall be taken when marking numbers, letters, and symbols. Each edge of applied HBAC shall be sharply outlined. Discontinue marking operations if HBAC exhibits slow drying or application equipment malfunctions.

### 3.3.3 Reflective Glass Beads

Reflective glass beads shall be applied immediately following final HBAC application and directly into wet HBAC. Reflective glass beads shall be uniformly distributed, soundly bonded to HBAC, and applied at the specified rate of coverage.

## 3.4 CURING

Installed HBAC shall cure and display performance equal to manufacturer's product literature. Improperly cured HBAC shall be removed and reapplied by contractor at contractor's expense.

## 3.5 FIELD TESTING AND INSPECTION

### 3.5.1 Sampling and Testing

Use one of the listed HBACs presented in Table II or have manufacturer submit HBAC test results confirming HBAC complies with the requirements of Table I. HBAC shall be tested by a qualified coating's testing laboratory to confirm compliance with the requirements of Table I. If a sample fails to meet one or more Table I requirements, the submitted HBAC shall be rejected prior to application. Submit copies of Table I test results to the Contracting Officer.

### 3.5.2 Inspection

Examine HBAC at the job site to confirm material is either the material referenced in the test report or a material listed in Table II.

#### 3.5.2.1 Surface Preparation and Application Procedures

Surface preparation and application procedures will be examined by the Contracting Officer to confirm specification requirements were met. Each operation shall be approved prior to the initiation of subsequent procedures.

TABLE I  
REQUIREMENTS FOR HIGH BUILD ACRYLIC COATING (HBAC)

Test	Minimum Requirement (maximum where indicated)
Resin System (ASTM-D-2621)	Waterborne 100 % Acrylic
Percent Volume Solids (ASTM-D-2697)	58 %
Volatile Organic Compound, max. (ASTM-D-3960)	150 g/l
White (Fed. Std. 595B)	37925
Yellow (Fed. Std. 595B)	33538
Shore D Hardness (ASTM-D-2240)	45
1/8" Mandrel Bend @ 5 mils Dry Film Thickness (DFT), one-week cure (ASTM-D-522, Method B)	No visual defects at bend (Conditions @ ASTM-D-3924)
Adhesion to Concrete and Asphaltic Pavements (ASTM-D-4541)	140 psi or 100 % cohesive failure in pavement
Accelerated Weathering, Yellow, 2500 Hours UV Exposure (ASTM-G-53: See Note 1)	Max. color loss to 33655 (Fed. Std. 595B)
Water Absorption @ 168 Hours Immersion Tap Water (ASTM-D-471)	9.0 % max. weight increase (Conditions @ ASTM-D-3924)
Application @ 65 mils Wet, One Coat, One-week Cure, (See Note 2)	No visual cracking or curling (Conditions @ ASTM-D-3924)
No Pick-Up @ 25 mils Wet (ASTM-D-711)	10 minutes max.
Lead (ASTM-D-3335)	0.06 % max.
Cadmium (ASTM-D-3335)	0.06 % max.
Chromium (ASTM-D-3718)	0.00 %

NOTES:

(1) Properly mix and apply yellow paint at 250 microns  $\pm$  50 microns (10 mils  $\pm$  2 mils) DFT over a suitably sized, clean aluminum substrate (ASTM-D-823), and cure for a minimum of 48 hours: four individual yellow samples shall be prepared. Expose three samples to continuous Ultraviolet (UV) light for 2500 hours, without cycled condensation, in accordance to ASTM-G-53: UVA-340 lamps shall be used in the testing apparatus. Following exposure, compare the three exposed samples to the "one" non-exposed sample using Fed. Std. 595B colors 33538 and 33655 as visual references: evaluate exposed samples for degree of visual color loss. Yellow paint shall receive a passing rating if each exposed sample appears visually equivalent to the non-exposed sample and, in addition, displays color loss no greater than Fed. Std. 595B color 33655.

(2) Using 3M double-stick, foam mounting tape (or equal) with a nominal thickness of 1625 microns (65 mils), apply a rectangular mold with inner dimensions of 7.6 cm x 25.5 cm (3 in x 10 in) to a clean aluminum sample approximately sized at 15 cm x 30 cm x 0.30 cm (6 in x 12 in x 1/8 in). Do not remove the tape's plastic backing. Mix and apply excess paint into mold. Remove excess paint, by squeegee or other appropriate draw down technique, to a uniform thickness equal to the tape's height. Paint application and draw down shall be performed within a period of no more than 60 seconds. Approximately one to two minutes following draw down, remove tape from sample and allow coating to cure for a minimum period of one-week (ASTM-D-3924). Using a micrometer or other appropriate device, measure cured coating thickness (less sample thickness) to confirm resulting coating application was at or above 950 microns (38 mils) DFT. Inspect coating for visual signs of cracking and curling. Following a one-week cure, coating shall receive a passing rating if applied greater than 950 microns (38 mils) DFT and visually free of both cracking and curling.

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TABLE II  
PREAPPROVED HBACs

Products	Manufacturer
Legend Build, #2712A9, White Legend Build, #2713A9, Yellow	TMT-Pathway 1021 N. Mission Road Los Angeles, CA 90033 (800) 338 - 7680
Pervo 6050, White Pervo 6053, Yellow	Pervo Paints 6624 Stanford Ave. Los Angeles, CA 90001 (323) 758 - 1147
UC-1516, White UC-3588, Yellow	Vogel Traffic Services 1920 Albany Place South PO Box 140 Orange City, IA 51041 (712) 737 - 4016

-- End of Section --

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